AGRICULTURAL Research

DECEMBER 1953

Fixers of Plant Nitrogen

AGRICULTURAL
Research

VOL. 2—DECEMBER 1953—NO. 6

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Reorganization of USDA research

A reorganization of the Department of Agriculture, involving fundamental realignment of USDA research activities, was made effective by Secretary Benson on November 2. The former Agricultural Research Administration and its constituent Bureaus is now the Agricultural Research Service. This is one of six Department agencies in the new Federal-States Relations group, which also includes the Forest Service, Soil Conservation Service, Federal Extension Service, Agricultural Conservation Program Service, and Farmer Cooperative Service.

Most of the activities formerly in ARA have been regrouped under the Administrator, Agricultural Research Service, in two major categories, one for research, the other for inspection, regulatory, and control work. Some new activities have been brought into this Service, and some work formerly in ARA has been transferred to other agencies.

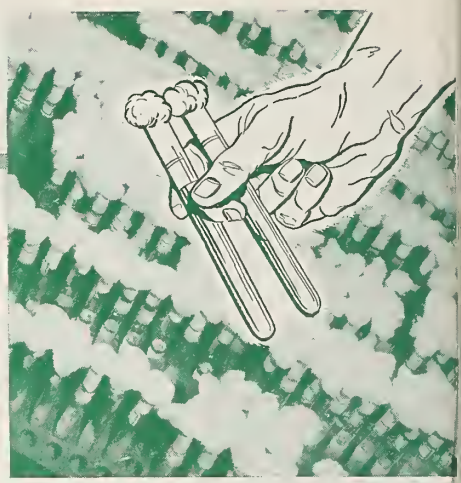
New activities include: (1) Research on farm management and costs, land economics, and agricultural finance from the Bureau of Agricultural Economics; (2) soil conservation research (except soil-survey investigations) from the Soil Conservation Service; (3) certain grass and range management research from the Forest Service; (4) cotton ginning and processing research from the Production and Marketing Administration; and (5) administration of the pesticides act, also from PMA.

Activities transferred to other agencies are (1) forest disease and pest research and control work to the Forest Service, and (2) off-farm handling, transportation, and storage research to the new Agricultural Marketing Service, which also absorbs a major part of the marketing, research, and service functions of PMA, as well as many functions of the Bureau of Agricultural Economics.

The Agricultural Research Service is organized in seven functional units. Five of them are research units, concerned with crop production, farm and land management, livestock production, human nutrition and home economics, and farm-product utilization. Two are regulatory units, for crop and livestock disease and insect control work and inspection and regulatory activities, including meat inspection.

A further report on the reorganization will appear in an early issue.

AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture



COTTON-STOPPERED test tubes hold live bacteria. They inoculate legumes, fix air's nitrogen for plant use. Bacteria bank helps develop better inoculants. (See pages 14–15.)

Contents

Return of the Chestnut 3
Parasites Help Fight the Pink Bollworm 8

FOOD AND HOME

Making the Most of Maple Flavor 5
Honey Can Improve Bakery Products 5

FRUITS AND VEGETABLES

Antibiotics for Perishables? 6
Saving on Citrus Shipments 6
Plastic Liner Helps Store Fruit Longer 7
Pocahontas: New Strawberry for the South 7

LIVESTOCK

Cutting Losses in Young Rabbits 10
New Gains Against Swine Erysipelas 11

DAIRY

Profit in Pasture Irrigation 13
Alfalfa Pellets for Dairy Cows 13

CROPS AND SOILS

Practical Partners: Legumes and Bacteria 14

Agricultural Research is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington 25, D. C. The printing of this periodical was approved by the Director of the Bureau of the Budget on August 19, 1952. Yearly subscription rate is $1 in the United States and countries of the Postal Union, $1.35 in other countries. Single copies are 15 cents each. Orders and remittances should be sent directly to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

OUR HARDWOOD WEALTH of American chestnuts, lost to blight on 10 million forest acres, may be recoverable in part through blight-resistant hybrids now being grown.

Return of the Chestnut

The last 50 years has been a "lost generation" for the American chestnut. These gigantic trees of our eastern forests are all gone—struck down by a blight that swept from Canada to the Gulf. But scientists were able to preserve some of their germ plasm by crossing the doomed trees with blight-resistant selections from the Orient. Now we are breeding hybrids that may someday restore the chestnut to its traditional place in America.

This breeding program began soon after the blight fungus hitch-hiked into New York Harbor, on plants introduced from Asia, and began its systematic destruction of the American chestnut. First discovered on chestnut trees in the Bronx Zoo in 1904, the fungus moved so fast—and our native chestnut trees were so susceptible—that all attempts to stop it were futile.

For a few years after the blight struck, scientists hoped that our native trees would develop a naturally resistant strain. The fungus did not attack the roots of the tree—only the bark, which was girdled by the disease as if it were cut with an axe. The root crown would continue to live for a while, sending up young shoots that often persisted long enough to bear viable nuts. The hope was that eventually one of these nuts would indicate some change in heredity, a mutation that would bring resistance into the germ plasm. But despite numerous trials, none was found sufficiently resistant.

In the meantime, the blight fungus was traced across the seas to the Orient. Plant explorers found chestnut blight in both Japan and China. More important, they discovered chestnut trees thriving in spite of it. Some of the trees that were hit by the disease had recovered; others were entirely resistant.

Here, then, was a source of genes carrying the needed resistance to blight. But the Oriental trees are low, spreading, and generally not suited to our forest conditions. The job was to combine the best characteristics of American and Oriental chestnuts.

Department explorers obtained seed from thousands of blight-resistant trees in the Orient. The Chinese chestnut proved the most valuable of the Oriental species, both in blight resistance and in quality of nuts. The scientists propagated those Oriental varieties that displayed timber-tree form. Then, at first blooming, the seedlings were fertilized with pollen from American chestnuts that had

HYBRIDS made by crossing blight-resistant Chinese chestnuts with the vigorous, timber-type American species have desirable qualities inherited from both parents. Trees in this trial planting are 18 years old. Hybrids planted in forests, woodlots, and pastures will produce high-quality nuts (top) that can provide an important source of food for wild turkeys, deer, bear, squirrels, and other wildlife.

escaped the blight or from sprouts of stricken trees that had matured enough to produce blooms.

G. F. Gravatt, pathologist at USDA's Plant Industry Station, says that one of the Chinese-American crosses, produced in 1935, resembles the American chestnut in rate of growth, form, and leaf shape. Resistance to blight is less than that of the Chinese parent but more than that of the American. These first-generation trees have increased about 2½ feet in height and about ½ inch in diameter each year. They are now fence-post size, and in 20 to 25 years—if they survive—they will be tall enough to cut for telegraph poles.

Some of the first-generation trees have been backcrossed to the original Chinese parent, and the progeny is practically as resistant to blight as the Chinese chestnut. Many of these hybrids retain the good tree form inherited from their American ancestors.

The Department has also been selecting Chinese varieties for orchard raising. H. L. Crane, who has been working on this project for many years, says that special selections of the Chinese chestnuts are as good for nut production as were our native chestnuts. Three orchard varieties—Kuling, Meiling, and Nanking—have been released to commercial nurserymen. The Chinese trees are well adapted to our eastern chestnut-growing areas and private nurseries report increasing sales for orchard and home plantings. Some State forest and wildlife agencies are growing and distributing chestnuts.

Commercial fruit and nut growers who have planted Chinese chestnuts on orchard land may well find them profitable. In 1938, the blight struck in Italy. It is making rapid inroads on the susceptible European chestnut. Gravatt recently visited Europe, and he reports that complete destruction of chestnuts in Italy is expected during the next few decades. This means we may be looking elsewhere for the 20 million pounds of chestnuts we import each year, mainly from Italy. Chestnut orchards planted now will come into full production as the world supply of chestnuts is diminishing.

The Department, in cooperation with the Foreign Operations Administration, is sending pollen, nuts, and scions (grafting shoots) from pure Chinese and Chinese-American hybrids to Italy for use in developing blight-resistant varieties to take the place of the European chestnuts killed by the disease.

The new blight-resistant varieties thus serve as a reservoir of germ plasm for use here and abroad to provide the fine wood and nuts characteristic of the native species. Through scientific breeding, we have kept the blood stream of the American chestnut flowing.

Making the most of MAPLE flavor

New production methods and new products developed through research are helping to bring the delicious flavor of pure maple sirup within the reach of more consumers.

This spring, many maple-sirup producers will collect sap from their sugar maples in plastic bags, instead of the time-honored wooden buckets. The bags have a special advantage—they permit sunlight to assist in making better maple sirup.

Scientists of the Agricultural Research Service's Eastern Regional Laboratory find that the sun's ultraviolet rays can penetrate the semitransparent bags, sterilize the sap, and prevent its spoilage by microbial fermentation.

Because of contamination by microorganisms, especially late in the season, maple sap often becomes discolored, ropy, or sour, and produces poor-quality sirup. But given sunlight and cool weather, the plastic collecting bags will keep the sap unspoiled, so that it can yield more sirup of the best grade.

Another recent innovation is the oil-fired evaporator, which is beginning to replace conventional wood-fired equipment for cooking the sap to produce maple sirup and sugar.

Tests made by the Eastern Laboratory show that properly designed oil-burning evaporators are more efficient producers of high-quality sirup. They can handle the sap about 30 percent faster than wood-fired evaporators of similar size, and so avoid slow cooking, which tends to darken the final product. Thus they provide increased output of the preferred light-colored sirup.

Previous work at the Eastern Regional Research Laboratory to improve processing and extend the use of maple products has led to large-scale production of a new, high-flavored maple sirup. It can be made with 4 to 15 times stronger flavor than top-quality sirup, yet lacks any caramel or other off-flavors. Mixed with cane or corn sirup, this product makes a superior blend that looks and tastes like good-grade pure maple sirup but sells for much less.

Two pure-maple concentrates made from the high-flavored sirup promise other new markets for maple products. One of them is a maple-sugar cake. The other is a thickened, high-flavored sirup. Both are used in bakery products, frostings, candy, and sundae toppings. They can be stored in little space and keep better than ordinary maple sirup. Prepared for home use, these concentrates permit the housewife to make an inexpensive but high-quality table sirup with full maple flavor merely by adding water and sugar.

Research shows that honey can improve quality of bakery products

By using honey to replace part of the sugar in baking formulas, commercial bakers can produce better bread, cakes, cookies, and other pastries, say researchers of the Kansas Agricultural Experiment Station.

In a 3-year study made under contract with USDA's Eastern Regional Research Laboratory, the State scientists found that honey improved the color, flavor, and texture of most bakery products, increased their ability to hold moisture, and so helped them stay fresh longer. Fruit cakes made with honey, for example, have richer flavor and superior slicing quality.

L. B. Smith and J. A. Johnson of the Kansas experiment station have determined the most suitable types of honey and the proper quantities to use in different baked goods. Desirable amounts range from about 5 percent of the total sugar content of bread and cookies to 40 percent or more of the sugar in cakes.

It was long believed that normal variations in honey's chemical properties would severely limit the use of this natural sweet in baking. Smith and Johnson found, however, that only the flavor and color of honey have much effect on the uniformity of bakery products made with it. And if the honey is properly selected, according to specifications they have developed, its general use by commercial bakers should give good results.

Farmers depend a great deal on the honeybee for pollination of many fruit and seed crops. Extending markets for honey should encourage beekeepers to stay in business and maintain honeybee populations at the desired high levels. The Kansas studies, therefore, point toward advantages from wider use of honey that may benefit agriculture generally, the baking industry, and consumers.

Antibiotics for Perishables?

Fresh spinach in transparent plastic bags can't be kept more than a day or two without refrigeration. Soft-rot bacteria will soon turn it into slimy green mush.

These quick-acting decay organisms cost us literally millions of dollars a year. The waste they cause must be paid for eventually by all concerned, from the truck farmer to the consumer. Adding even one day to the shelf life of leafy vegetables at ordinary temperatures would mean large savings.

At USDA's Plant Industry Station, W. L. Smith, Jr., has shown how antibiotics might help do the job. By spraying spinach with streptomycin before harvest, or by dipping the leaves in a dilute solution of the drug after harvesting, he postponed decay in the film-packed product for approximately 2 days.

This process cannot be used yet commercially, because we don't know what effect the drug might have on consumers. When present in edible products, antibiotics are considered adulterants—in other words, their use for food preservation is illegal.

The experiments demonstrate, however, that something can be done about soft-rot bacteria. Previous efforts to retard their spoilage of fresh fruits and vegetables have failed. Smith's work is a successful skirmish in the long siege against perishability, which still blocks the way to more efficient production and marketing of farm products.

Leafy vegetables are normally put in cold storage (40° F.) immediately after prepacking. This delays the appearance of decay. But soft-rot bacteria multiply rapidly when brought to room temperature (70° to 85° F.), and they can soon make the produce worthless.

For most of his tests, Smith used a water solution of 0.1 percent streptomycin. A crude form of the drug proved as satisfactory as the more expensive purified product, if enough was used to maintain the solution's level of active streptomycin. Crude terramycin also worked well. Aureomycin was slightly less effective. Postharvest dip treatments gave somewhat better results than preharvest sprays.

All the spinach tested was inoculated with soft-rot bacteria before packaging. This insured uniform presence of decay organisms but made the test conditions more severe than those found in normal marketing.

Control samples given no antibiotic showed decay after 1 day at 70° F. They were badly decayed after 2 days. On the third day, the spinach became a mushy, foul-smelling mass. In streptomycin-treated packs, however, little or no decay occurred in the first 2 days, and they did not turn mushy till the fourth or fifth day. Even then, the treated packs had no offensive odor.

Some antibiotic was absorbed by the leaves of treated spinach and could not be washed out. What effect cooking the spinach has on this drug residue is one of several questions about the process that are scheduled for further investigation.

Savings on citrus shipments

Buying refrigeration service used to be a guess—often a costly one—for Florida citrus shippers. But not any more, because research has provided a transit refrigeration schedule that shippers can use just as growers use a spray schedule.

This guide will help select the best and most economical protection for every carload at every season.

Behind the schedule are several years of research, including 600 shipping tests from Florida—which grows 60 percent of the country's oranges and 85 percent of its grapefruit. The tests were conducted by USDA transit-research specialists, J. R. Winston, H. W. Hruschka, R. H. Cubbedge, and G. A. Meckstroth.

Many types of refrigeration service are available. Up to now, however, even the veteran shipper hasn't always known what kind of service he needed. For example, in test shipments to New York one fall, some cars were sent under "standard refrigeration" (several re-icings enroute) at a cost of $63.48 per car. Other cars went under a free service that provided an initial icing and one re-icing. Fruit in both groups arrived at much the same temperature.

Shippers needed more information: What transit temperatures can be expected with various icing and ventilation services? How do these temperatures affect the condition and keeping quality of the fruit?

Main purpose of transit refrigera-

ion is to control decay—that is, rots brought on by fungus growths. Research showed decay is unlikely in the first week or 10 days when oranges are held at about 50° F. Fortunately, temperatures low enough to control rot also retard rind breakdown such as pitting and decay.

Transit researchers now saw the possibility of putting the weather to work for citrus shippers. Studies were made of temperature records on the northbound rail routes to East and Midwest markets. This showed that outside air temperatures north of Florida are low enough during much of the shipping season to cool fruit rapidly without refrigeration.

The shipping tests were made with market-bound commercial loads. These included fruit from different areas, in different types of packages, and at different stages of maturity. Some loads were precooled by various methods. The trips covered all kinds of weather from October to June. Protective services, ranging from standard refrigeration to ventilation alone, were varied according to outside temperatures.

Scientists got a complete fruit-temperature story of each trip by means of recording thermometers placed in crates or bags. Fruit from the test packages was inspected on arrival and again after being held a week at room temperatures.

The tests indicated that two factors—condition of fruit at packing, and temperatures in transit—are most important in decay and rind breakdown. In general, they were worst when the average temperature of a shipment ran over 60°.

Prudent use of ventilation yields big savings. There's little danger of freezing fruit moving under ventilation—even at temperatures as low as 25°—unless exposure is long.

Refrigeration is essential in warm or borderline weather. Even then, shippers can often save by modifications of the icing service. If unloading is delayed in hot weather, it may be necessary to replenish bunkers with ice to protect the fruit.

Cooling is especially important at the beginning of a trip, when fruit temperature may run in the 80's. Shelf life is often shortened when delays in refrigeration at the shipping point allow rot organisms to get a good start. Thus, precooling is usually desirable in warm weather. Fan cars cool loads faster and more uniformly than nonfan cars.

A large number of transportation, shipping, and receiving agencies cooperated in this study. Details, including refrigeration schedule and temperature records, are given in Handling, Transportation, and Storage Office Report No. 305. This is available from W. T. Pentzer, Plant Industry Station, U. S. Department of Agriculture, Beltsville, Md.

Plastic liner helps store fruit longer

Lining boxes of pears and apples with plastic film can give the fruit a longer marketing season. ARS scientists find that pears sealed in film keep well in storage at 31° F. for a month or two longer than when packed without film, and they still ripen with excellent quality. Golden Delicious apples in plastic-lined boxes maintained better appearance and eating quality than standard packs after 6 months in cold storage.

These are results of studies by Fisk Gerhardt and H. A. Schomer at the U. S. Horticultural Field Laboratory, Wenatchee, Wash. Many films—polyethylene, pliofilm, and other plastics impervious to water—proved satisfactory with Bartlett, Anjou, Comice, and Bosc pears. Golden Delicious apples, which lose moisture easily and may shrivel, benefited from the plastic liners more than other apples tested.

Plastic-lined boxes are recommended only for sound fruit (1) washed in an effective fungicide and (2) intended for late storage. In general, the studies showed, it's better to perforate or slit the sealed liners when the fruit is removed from cold storage. This prevents possible development of off-flavors at higher temperatures.

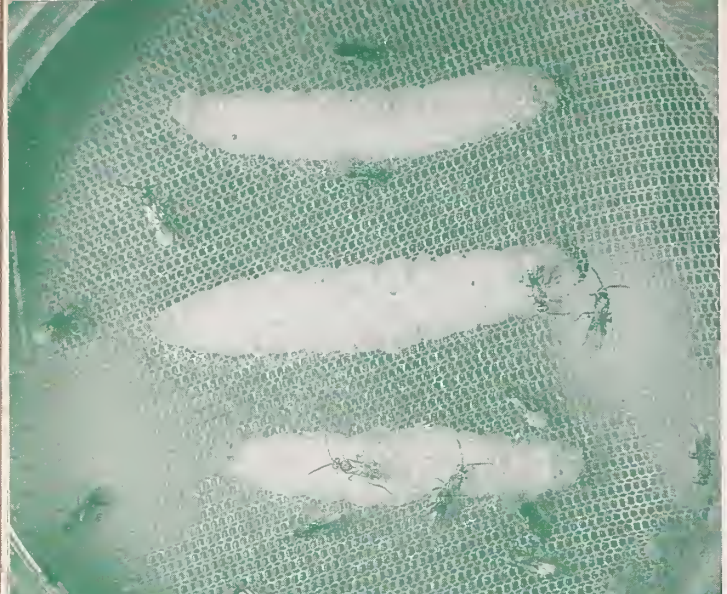
Strawberry for South: Pocahontas

A high-yielding new strawberry for the South, named Pocahontas, has been developed by plant breeders of the Agricultural Research Service in cooperation with the Virginia Truck Experiment Station. Tested from New Jersey to North Carolina and west to Arkansas, it appears well adapted as a midseason variety throughout the south central States.

Pocahontas does especially well in eastern Virginia, producing an excellent spring crop on fall-set plants. Yields at Beltsville, Md., from 1951–1952 spring plantings averaged 474 crates (24 quarts each) per acre.

Pocahontas berries, compared with those of the widely grown Blakemore variety, ripen 5 to 7 days later, are usually larger and deeper red in color. Their texture, color, and flavor make them fine for freezing.

This new strawberry is a 1948 selection made at the ARS Plant Industry Station from a 1946 cross between Tennessee Shipper and Midland varieties. A list of cooperating commercial nurseries that can supply Pocahontas plants may be obtained from the Information Division, Plant Industry Station, Beltsville, Md.



PARASITIC WASPS, enemies of the pink bollworm (shown here about 2 times natural size), deposit eggs on larvae of European corn borer. Since borers are not natural hosts of the parasite, they must be "coddled" in hot water to kill and soften them for wasp breeding. Then they are put between nylon screens covering the glass rearing cylinder. Wasps confined inside cylinder, attracted upward by light, lay their eggs on corn-borer larvae through nylon mesh from below. Some wasp species prefer live larvae or eggs of the rice moth. Both corn borers and rice moths are used at New Jersey wasp-breeding laboratory to avoid moving the bollworm out of the cotton-growing areas in Arizona, New Mexico, Texas, Oklahoma, and Louisiana where it is quarantined.

Parasite

A QUARTER MILLION tiny wasps were turned loc in Texas last summer to combat cotton's most dangero enemy, the pink bollworm. Scientists hope these inse have now established themselves in the South's bollwor infested area. If all goes well, they should breed n wasp generations this spring to help farmers prot their 1954 cotton crop against bollworm attack.

These wasps are natural parasites of the pink bollwor Their forebears were brought to this country less thar year ago from India, the bollworm's original home. Ca fully nurtured by entomologists at USDA's insect-paras receiving station, Moorestown, N. J., they multiplied i the large populations that were shipped south for test Rio Grande Valley cotton fields.

Now, as the parasite-breeding program in New Jer continues, researchers in Texas wait to see whether wasps will reduce next year's bollworm damage.

Five species of parasitic wasps have been sent fr India by G. W. Angelet, insect explorer of the Agric tural Research Service. (Shipments made so far incl *Bracon brevicornus*, *Bracon gelechiae*, two unidentil species of *Chelonus*, and one of *Apanteles*.) Adults different species vary in habit, laying their eggs in or the bollworm or its eggs. As the wasp larvae devel

CAN open at bottom and resting on aluminum foil holds adult rice moths. Their eggs and larvae are used to breed bollworm parasites.

TOP VIEW of container with cover removed shows rice moths clustered on screen in can. Eggs they lay drop through screen onto foil.

MOTH EGGS are separated from wing s and other debris. Some are hatched, o are used immediately for parasite bree

help fight the PINK BOLLWORM

they destroy their bollworm hosts. Life cycles of the wasps, which also vary with the species, last only 2 to 6 weeks during the cotton-growing season.

To avoid risk of spreading the pink bollworm, it was not used to breed the large numbers of parasites needed for the Texas trials. Instead, D. W. Jones and his assistants at the New Jersey laboratory devised means of utilizing two local insects—the rice moth and European corn borer (see pictures). In the field, however, the wasps parasitize only the pink bollworm.

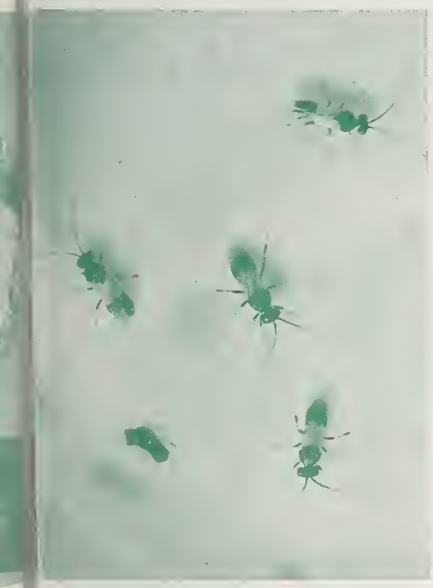
All the wasps shipped to Texas this year were reared in 15 glass cylinders, each only 1½ inches in diameter and 6 inches high. With this equipment, the scientists at Moorestown can rear out half a million or more adult parasites in 1954. Millions could be raised, if needed, with larger facilities.

Use of beneficial insects to control insect pests is of course not new in American agriculture. One of the first successful importations was an insect predator—the vedalia beetle. Brought to California from Australia in 1888–89, it soon controlled the cottony-cushion scale, a serious pest of citrus.

In the past 50 years, many other parasites and predators have been introduced for biological control of insect pests. Though some proved of little value, others controlled or materially reduced insect infestations. Among the most valuable have been parasites of the alfalfa weevil, European corn borer, several mealybugs and scales, and a number of forest insects in this country, and the citrus blackfly in Cuba and Mexico.

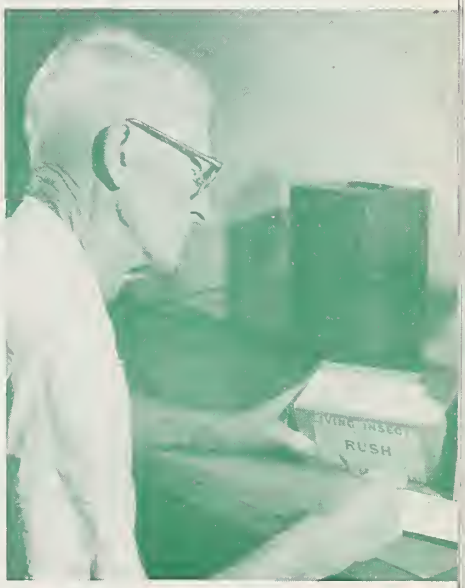
This spring, when entomologists find out how well the parasitic wasps have become established under American cotton-growing conditions, they can plan the next step in their biological campaign against the bollworm. Scheduled future work already includes a study of insect diseases that may affect this cotton pest. A new laboratory, just completed for the Agricultural Research Service near Brownsville, Tex., will be a center for this and other pink-bollworm research.

Scientists in USDA and State experiment stations are working to develop better bollworm insecticides, including plant systemics; to devise improved cultural practices for cotton that will work against the pest; to breed bollworm-resistant cotton varieties; and to explore other control possibilities (see AGR. RES., March–April 1953). As we found with the European corn borer, it will probably take more than one agricultural weapon to halt and push back the pink-bollworm invasion.



ASPS of *Chelonus* species lay eggs in rice-th eggs. Larvae of rice moths hatch, are stroyed as wasps develop inside them.

COLLECTING tiny adult wasps for shipment is done with screen lighted from rear and hair drier modified to suck the insects into carton.



WRAPPED in wet paper towel to give wasps needed moisture, then in waxed paper, cartons are boxed and sent by air mail to test area.

Cutting losses in young Rabbits

Aureomycin and vitamin B_{12} can help breeders save domestic rabbits. This antibiotic-vitamin combination was added to rations at USDA's Rabbit Experiment Station, Fontana, Calif. As a result, losses of young rabbits from enteritis were reduced by a whopping 75 percent.

Since enteritis is the number-one killer of domestic rabbits, the Fontana findings can mean big savings to the rabbit industry.

The business of raising rabbits mushroomed during World War II, when meat was generally scarce. Now there are some 134,000 growers, located in all 48 States. They produce 50 to 60 million pounds of rabbit meat a year—worth about $25 million at current wholesale prices. The pelts of most of these rabbits also find a market, as garment linings and trimmings, toys, and other items.

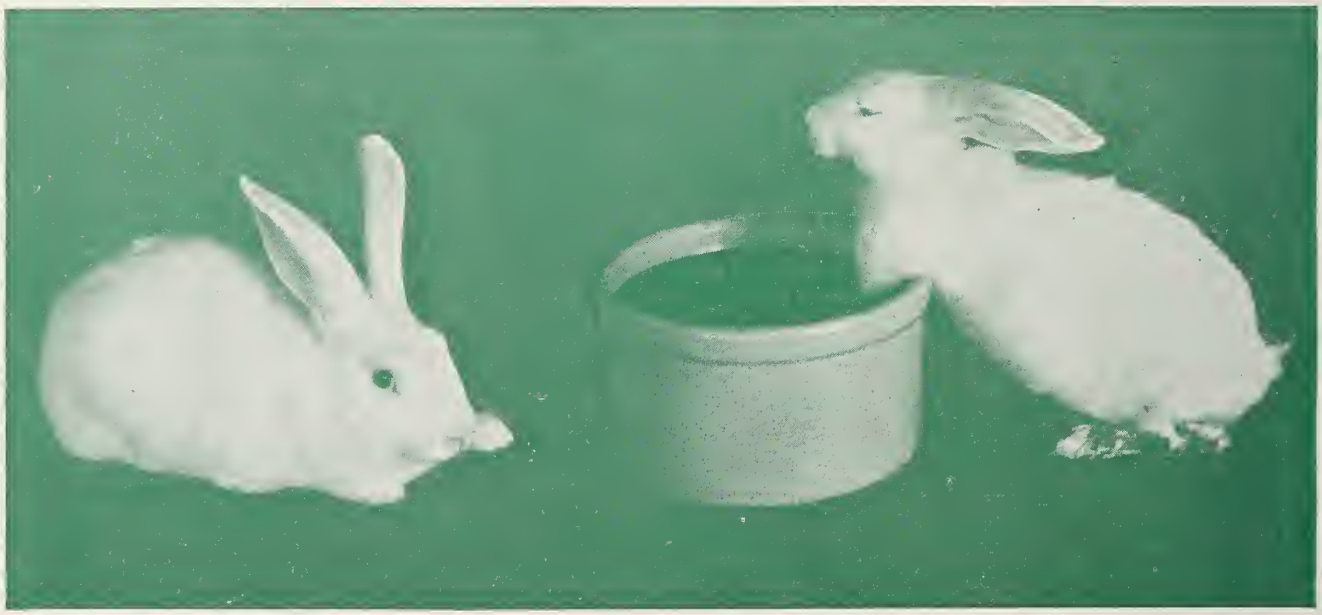
Mucoid enteritis (also called bloat, scours, or diarrhea) causes about half of all rabbit deaths that occur during the suckling period. Commercial breeders in the Los Angeles area alone figure their annual losses from the disease cost them nearly a million dollars.

This disorder is baffling to researchers. Attempts to produce it experimentally have failed. Apparently it is neither infectious nor contagious. Sanitary measures have little if any preventive value. Many different rations have been tried, but none previously was effective as a cause or cure of the disease.

Enteritis hits rabbits hardest at 5 to 7 weeks of age—shortly before market time. Besides heavy death losses, it costs additional feed and labor to bring animals that recover back to market condition.

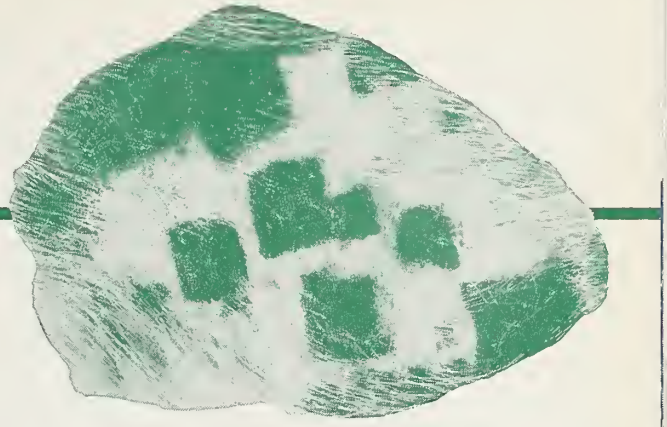
Success in using antibiotics and vitamin B_{12} in feed for poultry, hogs, and dairy cattle led scientists at the Rabbit Experiment Station to try them against enteritis. They fed a supplement containing 2 grams of aureomycin and 1.8 mg. of vitamin B_{12} per pound, incorporated in a pelleted ration at rates of 5 and 10 pounds per ton of feed. The test was made over a 17-month period, using 72 New Zealand White does and their 188 litters of 1,379 young.

The aureomycin-B_{12} combination eliminated three-fourths of normal losses from enteritis. Feeding the supplement at the 5-pound level was just as effective as at the 10-pound level—and more economical. The antibiotic and vitamin had no observable effect on the rabbits' rate of growth or conception, or on pneumonia and other diseases.



NEW ZEALAND WHITE rabbits make good fryers. The pelts bring top prices in their class. Healthy rabbit (left) has alert eyes, erect ears, plump body, smooth coat. Animal on right shows typical signs of mucoid enteritis—pinched face, squint eyes, prone ears, bloated but underweight body, rough coat. Putting front feet in water crock is a common symptom. Disease causes severe thirst and rapid weight loss.

NEW GAINS against SWINE ERYSIPELAS



SWINE erysipelas can be a killer and a crippler. Few diseases have been as baffling, and only hog cholera costs hog raisers more money. But encouraging news has just come out of research by the Agricultural Research Service's R. D. Shuman. His findings may help explain some mysteries of this disease and point to better methods of control.

Acute swine erysipelas breaks out suddenly, often striking many animals in a herd at once. Temperatures flare and pigs go off feed. Pain and swelling in the joints cause sick pigs to lie in their bedding. Lameness and arched backs may appear. Some animals may die in a few days.

Red patches, which give rise to the name "diamond-skin disease," sometimes show up in bad cases but usually go with the less acute form of erysipelas. Portions of skin, ears, and tail may slough off when these patches spread over big areas.

Death losses are only the beginning of trouble. Stunted survivors, often left with heart growths and chronic arthritis, make slow gains. And poor, knotty-legged hogs are sure to be docked at market.

Swine erysipelas has been a problem in Europe for over a century. At one time, it was confused with anthrax. France's Louis Pasteur was among those credited with isolating erysipelas bacteria in the 1880's.

Veterinarians have always had trouble with erysipelas. For one thing, it's hard to diagnose. Many of the symptoms are common with other swine diseases.

Furthermore, there seem to be different forms of erysipelas. Death losses are larger in Europe than in America. But we probably have more of the chronic type of infection.

Most puzzling problem of all was the difficulty of reproducing the disease experimentally in swine. No one could infect pigs with any consistency. Some scientists thought there might be differences in the deadliness of the organism. Others suggested that some breeds or families of swine may carry natural resistance. Age, diet, and soil were suggested as possible factors.

All may play a part. Shuman believes, however, that the most important point of all has been overlooked. This is immunity resulting from natural exposure to the disease.

He bases this contention on work with the skin-scarification method of producing the infection, developed by German scientists in the 1940's. Live bacterial culture is swabbed into several scratches on the side of the pig. Shuman found that susceptible animals come down with erysipelas, and a few even die. Immune animals aren't affected at all. Susceptible animals that react and then recover from erysipelas become immune.

When pigs from different farms are tested, a variety of reactions could be expected. Some pigs could be completely susceptible, others could be lightly infected, and some could give no reaction, showing immunity. This can be explained by the fact that mild cases of erysipelas may occur and go unnoticed, yet be active enough to set the blood stream to work producing antibodies that are ready to combat an invasion of erysipelas.

It's easy to see how pigs could pick up such infection when we consider that the tough erysipelas organisms may live around a hog lot for years. Normal-looking animals can carry the bacteria and pass them on in body wastes. Other pigs are exposed through eating and drinking and wound infection. This might go on for some time before a serious outbreak occurs. In the meantime, mild infections may result in immunity.

Perhaps, then, researchers had trouble creating infection simply because they were dealing at times with animals that were already immune.

Immunity is the basis of attempts to prevent erysipelas. One of the early methods was to induce pigs to build up antibodies by a small injection of weak bacteria, followed by another stronger dose. Although the scheme worked in many cases, it often brought on the disease itself instead of active immunity.

Another method was to give pigs a shot of serum—the liquid portion of blood—that already contained the antibodies. Such serum was produced by injecting increasing quan-

tities of erysipelas bacteria into a horse. A shot of this fluid gives pigs passive immunity to erysipelas in a matter of hours. The trouble is that the effect lasts only a few weeks.

In the 1890's, French scientists hit on the method—still used today—of producing lasting immunity by using culture and serum together. Bacteria introduce the threat of disease, causing the blood to build up antibodies, and serum keeps the infection from getting out of hand.

The United States started a long-time field experiment with culture-serum vaccination in 1938, when swine erysipelas had become a serious problem in the Corn Belt. The Agricultural Research Service, State experiment stations, and State livestock sanitary authorities cooperate in this work, which now includes 26 States. It's carefully controlled, since general use of culture might set up new centers of infection.

By 1948, some 12,000,000 animals had been immunized by culture-serum vaccination, and a report was issued. Results indicated that the method had considerable value.

But this estimate still couldn't be checked in the laboratory because there was no way to infect experimental animals consistently.

Then the skin-scarification test gave Shuman the tool he needed.

First question he set out to answer was, How long does culture-serum vaccination protect baby pigs? He had 175 pigs vaccinated a few days after birth. Then at 8, 9, and 10 weeks after vaccination, he exposed them to erysipelas by means of the skin test. Only 37 percent resisted infection. The figure dropped to 13 percent at 12 weeks and continued to fall through 27 weeks.

It was clear that culture-serum vaccination had only limited value for protecting these pigs through weaning age, and no value at all for guarding them up to market time.

Other research indicated that vaccination of older animals might be more successful. So Shuman tried culture and serum on 161 weaner pigs just under 2 months old. As in the first experiment, he checked their immunity with the skin test.

At 6 to 10 weeks after vaccination, 73 percent of these pigs showed protection. Nearly 60 percent were protected through the average market age of 5 to 7 months. And even 23 to 27 weeks after vaccination, 47 percent still had protection.

These results were encouraging, but there was still a problem of protecting baby pigs up to weaning age. Double treatment would not be economical for hog raisers.

An accident led to Shuman's next step. He had given a gilt the skin test, not knowing that she was pregnant. She gave a susceptible reaction and farrowed about 5 weeks later. One of her pigs tested shortly after birth was completely immune.

Shuman now vaccinated six mature gilts with culture and serum before breeding. He discovered that baby pigs from these gilts were immune through the sixth week and had some protection up to the eighth week. Furthermore, immunity persisted in the sows for at least 8 months.

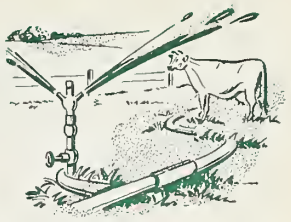
This suggests that hog raisers may eventually be able to defend against erysipelas with two steps: (1) Gilt vaccination to protect the pigs to weaning; (2) weaner-pig vaccination to carry them on to market.

Before such a plan is recommended in the field, however, it must be demonstrated that these two steps will work together toward immunization of the pigs. We must also check the possibility that serum shock—an allergic reaction—might appear after repeated injections of serum.

There's much to learn about this disease. With a better understanding of the mechanics of infection, better control methods can be developed. What factors influence susceptibility to infection and response to immunization? How important are breeding, diet, and soil? What effect may antibiotic feeding have? How does immunity develop in pigs farrowed by vaccinated gilts?

Shuman's success with skin-scarification indicates that this test may help find some of the answers.

SCRATCHES swabbed with swine-erysipelas bacteria brought on the disease. Note dark patches on side and ham. This technique, called skin scarification, proved pig susceptible.



Profit in pasture IRRIGATION

Supplemental irrigation is good insurance against loss of pasture during dry periods. Some farmers say they can save enough pasture in one dry year to pay the cost of their irrigation equipment.

These reports are confirmed by tests at Lewisburg, Tenn., made cooperatively by USDA dairy scientists and the Tennessee Agricultural Experiment Station. Results of the first 2 years' work demonstrate that supplemental irrigation can be a worthwhile investment for dairymen.

Even in areas that usually have enough rain to keep pastures growing throughout the season, a dry spell may come along and greatly reduce grazing capacity. At Lewisburg, for example, rainfall from April through October 1951 was only 20 inches, instead of the normal 28 inches. This situation is common in many eastern and southern States.

A creek-bottom pasture was established for the test in August 1950 by seeding a 9-acre field to a mixture of orchard grass, Ladino clover, and alfalfa. In April 1951, the field was divided in half. Then comparable groups of cows were grazed on the two plots through October.

After dry weather set in, one of the pastures was irrigated. A total of 24 inches of water was pumped from the creek in 18 applications. Irrigation equipment included a gasoline-operated centrifugal pump, portable aluminum pipe, and rotating sprinklers. A similar procedure was followed in 1952.

Here are the results: During the 2 years of the test, the irrigated half of the pasture averaged 49 percent more standard cow-days of grazing, 54 percent more milk production per acre, and 38 percent more income above costs than the nonirrigated plot. This amounts to an increase in net return from the irrigated pasture averaging $115.53 per acre.

Tests show value of alfalfa pellets in rations for dairy cows

How can you maintain milk production and still use poor-quality hay?

This is a question every dairyman faces at one time or another. What he does about it may mean the difference between a profit and a loss for his year's operations. Scientists of the Agricultural Research Service and the Connecticut Agricultural Experiment Station say dehydrated alfalfa pellets can provide the answer when feed and milk prices are right.

In studies just completed, cows that were fed alfalfa pellets to supplement poor-quality hay produced 25 percent more milk than those receiving no other roughage.

Four groups of 6 cows each were given a control ration of grain and U. S. No. 2 timothy-mixed hay for a preliminary 30-day standardizing period. Then three of the groups had dehydrated-alfalfa pellets added to their ration at different rates—0.5, 1.0, and 1.5 pounds, respectively—for each 100 pounds of body weight.

At the end of 100 days, production of the cows fed only the control ration had fallen off 27.2 percent. The three groups fed the alfalfa-pellet supplement fared much better. Those receiving one-half pound of supplement per pound of body weight were producing only 15.2 percent less milk, those fed 1 pound, 3.6 percent less, and those fed 1½ pounds, only 0.7 percent less. These differences in production are credited to higher intake of total digestible nutrients by cows fed alfalfa pellets.

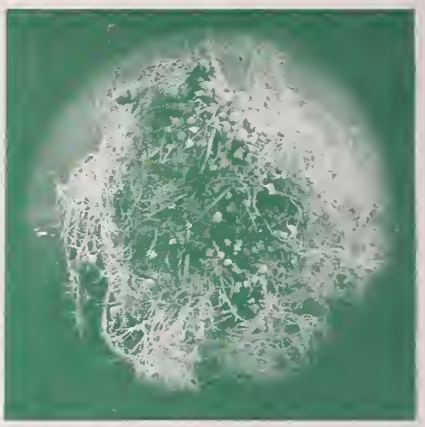
Whether farmers can profit by feeding alfalfa pellets depends on the price of hay, concentrates, and milk. If cost of the pellets is about midway between that of hay and feed concentrates, adding pellets to the ration will probably pay. Milk prices, of course, help to determine whether income from the extra milk produced will outweigh the cost of pellets.

Pelleted alfalfa also benefits young dairy calves as a source of forage and carotene to supplement starter pellets. This was demonstrated several years ago in cooperative studies at the Connecticut station. Tests were made recently to find out how much pelleted alfalfa should be fed and how fast the amount should be increased to produce maximum growth.

Holstein calves were fed mixtures of calf-starter pellets and alfalfa-hay pellets along with limited amounts of whole milk to 91 days of age. The alfalfa pellets were added to the ration in four different amounts, and each amount was increased at three different rates per week. The calves ate most and grew fastest when pellets were begun at about 18 percent of the ration and were increased 1.2 percent each week.

With information obtained from these studies, practical rations can be worked out that should prove valuable to dairymen, especially at times when they lack good-quality hay for their dairy calves.

TEST SHOWS whether a strain of bacteria can effectively inoculate a legume. Seeds are planted in sterile sand; bacteria culture is added. Solution (lower jar) provides water and nutrients—except nitrogen. Large, deep-green, vigorous plants indicate that bacteria are supplying needed nitrogen. New strains are checked yearly to find best for each legume.



NODULES on taproot are sign of infection by nitrogen-fixing bacteria in culture mixed with seed at planting. Nodules on lateral roots are usually produced by bacteria already in soil. Bacteria are isolated from nodules, tested, and stored for future use.

PRACTICAL

Legumes, an American agriculturist once remarked, "not only work for nothing and board themselves. but they pay for the privilege." Farmers everywhere know that legumes give this good account of themselves because of a unique group of bacteria.

Legume-plant roots (see pictures) are the home of these microorganisms. They have the ability to absorb and fix nitrogen from the air, so that it becomes available to the bacteria's host plant.

The arrangement is advantageous to legumes and bacteria alike—and highly satisfactory for the farmer. Protein-rich legumes need plenty of nitrogen, an expensive chemical element to buy. A well-inoculated legume crop makes its own nitrogen.

But science still has a lot to learn about the legume-bacteria partnership. L. W. Erdman and U. M. Means, working at the Plant Industry Station, are helping to find the answers as they search for better strains of bacteria and improved methods of inoculation.

Every year these scientists isolate new bacteria from soil and nodules collected around the world. Promising finds are added to a legume-bacteria bank that now contains more than 1200 strains. Starter cultures are supplied to firms that make inoculants for farmers.

Legume bacteria are choosy. For example, those that fix nitrogen on alfalfa won't work on clovers, peas, beans,

LEGUME bacteria (*Rhizobium*) are active, vary in size, shape. Strains that work on one legume may be poor on another, and some crop varieties prefer specific strains. Legumes are also subject to parasitic bacteria that form nodules but do not fix nitrogen.

INFECTION thread starts as bacteria enter through the root hairs. Branching thread enlarges, breaks, releasing bacteria in plant cells. Normal root growth by cell division further spreads bacteria. They multiply to fill cell, which swells from inner pressure.

SWOLLEN cells of infected area result in nodule on legume root. Plant's vascular system transports sugar, or energy material, to nitrogen-fixing bacteria in this nodule and carries away nitrogenous compounds for use in building proteins in leaves, stems, seed.

PARTNERS : legumes and bacteria

or soybeans. And the effective organisms for these last four plants are worthless for alfalfa. Fortunately, it's not necessary to provide a separate culture for each of the 50 legumes grown in this country. Scientists simplified this problem many years ago when they found that a number of strains can be combined in one culture to inoculate several related legumes. Farmers now buy cultures in seven cross-inoculation groups.

But the matter is far from settled. Further research has shown that many points must be considered in building good group mixtures of bacteria:

(1) Some strains work best on only one species of legume—or even on a single variety. (2) Of the bacteria that work on any given legume, some are good nitrogen fixers, many are mediocre, and others are poor. (3) Some poor strains can invade a plant and prevent the activity of a good strain. (4) There are parasitic strains that live in the roots and produce nodules but fix no nitrogen at all. (5) Effective bacteria must be found for the new legume varieties released from time to time.

It's plain that culture production is a complex problem, but a great deal of progress has been made. Today's commercial cultures are highly reliable.

Yet, legume crops sometimes peter out for lack of nitrogen because the inoculation fails to catch. Why?

Causes of such failures are being studied in 16 experiments recently begun in cooperation with Southeastern stations. Records are kept on temperature and rainfall as well as on moisture and temperature of the soil. Samples of test-field soil are undergoing chemical and mechanical analysis. Field trials are supplemented by fundamental studies in the greenhouse.

Over a 5-year period, many special cultures will be compared with commercial mixtures. Researchers will test different methods and rates of applying inoculant to seed. Also to be checked is whether adding chemical nitrogen will help plants get off to a better start. Some of the trials will be run on irrigated fields.

This work should tell us much about the physical, chemical, and biological factors that affect bacteria.

In the meantime, says Erdman, more farmers ought to use the good commercial cultures available. Inoculant is being applied on less than a fifth of the 75 million acres planted to legumes each year in the United States.

It's rarely safe to assume that soil contains enough effective bacteria to inoculate a legume, even when that crop has been grown on the field before. Many bacteria are sure to be lost from sun and drought, acidity and lack of food, hard rains and poor drainage.

More about the legume-bacteria partnership can be found in the revised USDA Farmers' Bulletin No. 2003, "Legume Inoculation: What It Is; What It Does."

UNITED STATES GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS, WASHINGTON 25, D. C.

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AGRISEARCH Notes

Big benefits in wireworm control

Chemical treatments to control wireworms in the soil, developed by Agricultural Research Service entomologists, mean tremendous savings to growers of truck and other crops, especially on irrigated land. DDT, ethylene dibromide, and D-D mixture are the pesticides used. In one California county, bean yields on 6,600 acres treated with 20 pounds of 50-percent DDT per acre averaged 400 pounds per acre more than yields on untreated soil. Savings to growers were estimated at $550,000 the first year. Since DDT remains effective in the soil for four years, the treatment resulted in a production increase worth about $2 million in this one county on a single crop. That amounts to roughly twice the cost of all the Bureau's research on wireworms from 1924 to date.

Versatile insecticide blower

A new multi-purpose insecticide sprayer of the mist-blower type is now on the market. It was developed by the Connecticut Agricultural Experiment Station in cooperation with entomologists of the Agricultural Research Service. Truck gardeners, fruit growers, and nurserymen, especially, should find it useful.

Combining light weight (about 200 pounds) and reasonable cost with ability to do a wide variety of insect-killing jobs, the new blower can be equipped with different insecticide outlets as needed for treating nursery stock, row crops, pastures, orchards, mosquito-breeding areas, livestock buildings for fly control, low-growing shade trees, etc.

The mist blower produces smaller and more effective droplets of insecticide than ordinary sprayers. Its high-velocity air blast, which atomizes and disperses the insecticide, also agitates the foliage being treated, thus making the spray penetrate better. The blower makes good use of concentrated, suspension-type sprays, which often clog the nozzles of other sprayers.

This compact unit can be fitted on a pick-up truck, trailer, tractor, or other vehicle. It can be used to control insect pests on trees 40 feet high or handle row crops at 3 to 4 acres an hour.

MIST BLOWER, here mounted on pick-up truck to treat nursery stock, can do many insecticide-spraying jobs better than ordinary spray rigs.

U. S. GOVERNMENT PRINTING OFFICE: 1953